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## HIGHWAY PLANNING IN TURKEY

By H. E. Hilts, Assoc. M. ASCE

HIGHWAY DIVISION

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AMERICAN SOCIETY OF CIVIL ENGINEERS

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PAPERS

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HIGHWAY PLANNING IN TURKEY

BY H. E. HILTS,<sup>1</sup> ASSOC. M. ASCE

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SYNOPSIS

It was apparent to the Turkish people in 1947 that progress in highway construction and maintenance was seriously lagging, and in the public interest it was imperative from commercial, agricultural, and security viewpoints that steps should be taken to develop an over-all transport policy consistent with national needs. An opportunity to benefit by American assistance was first presented by *Public Law No. 75* (Eightieth United States Congress), popularly known as the "Aid to Greece and Turkey Program."

On December 1, 1947, a group of experienced highway engineers was sent to Turkey by the United States Public Roads Administration (later the Bureau of Public Roads, United States Department of Commerce). Although American grants or loans have paid for this technical assistance and for purchase of modern road equipment, the Turkish government itself has financed its road building and maintenance program.

The reaction of the Turkish people to this active program for highways has been surprisingly like that of the average American and the Turks are somewhat astounded by the rapidity with which their own engineers and workmen have been able to translate words into action. There is promise that the Turkish government will, within a period of a few years, develop a highway department that will compare favorably with highway departments in the United States.

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INTRODUCTION

Modern Turkey is a tight little republic in the bridge of Asia Minor which joins the Middle East with Western Europe and which in the past has witnessed the passage of many peoples, both in terms of world trade and of conquests. It is the legendary land of the Hittites, the Persians, the Greeks, the Romans,

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NOTE.—Written comments are invited for publication; the last discussion should be submitted by August 1, 1951.

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the Genoese, the Crusaders, and finally the Ottoman Turks of Central Asia. It was the land of Helen of Troy, the land which interested Jason in his search for the Golden Fleece. Paul of Tarsus traveled much in southern Turkey and the descendants of the Amazons still live in the northeastern section near the Russian border.

Turkey in Asia Minor, about 1,000 miles long from east to west and about 300 miles wide, is a little larger than Texas. It became a republic in 1923. With one eighth of the population and one tenth of the area of the United States, it has all-weather roads aggregating less than 1% of the mileage of similar roads in the United States. It has a population of 18,000,000—about 54 people per sq mile as compared to 44 people per sq mile in the United States.

Predominantly it is an agricultural nation. As lack of adequate highway facilities is no reflection on the ability of the Turkish nation to visualize and determine transportation needs, the first objective in transportation was to finance and build a network of 6,900 km of railroad to handle mass transport. In the short space of twenty-three years this was accomplished, except for a few extensions to be added in due course.

The determination of the Turkish nation to proceed in fulfilling its highway needs in an orderly manner is both rational and timely. In such a country of relatively short distances, in modern terms, highways can be built, bettered, and maintained at low cost. Increased mobility is an economic necessity; expensive animal transport can no longer be afforded. Agricultural and industrial development must not be retarded by lack of modern highway transportation. Fertile land too far removed from railroads to make products marketable should be brought into agricultural production by tapping these regions with farm-to-market highways. Improved highway transportation will make it possible for farmers to grow wider varieties of products, marketable in new trade centers farther from home, and thus will reduce the risks involved in relying on a single crop. Losses in weight of livestock caused by driving the animals to market could be conserved by trucking, as in the United States. Just as in the case of agriculture, improvements would result in all economic fields—mining, manufacturing, and fishing—as markets and sources of the products are brought closer together by better transportation.

Another ruling factor is that the terrain is unusually difficult. The approaches to the Anatolian plateau, at an elevation of about 3,000 ft above sea level, have made railroad location difficult and costs high.

The following units may be useful in converting from the metric to the English system of units:

Metric	English
1 kilometer.....	0.62137 miles
1 meter.....	3.28083 ft
1 metric ton.....	2,204.62 lb.
1 kilogram.....	2.20462 lb

#### THE PROBLEM

The 1947 rural road mileage of Turkey was estimated as 41,800 km. This total is divided into a proposed national system of 20,000 km and 21,800 km of

provincial roads. There are also about 100,000 km of city and village streets and other rural roads. Although 11,000 km are classified as having macadam surfaces, inspections have shown that the roads are deficient in width and are not structurally sound enough to carry the increasing motor traffic. Likewise most of the bridges are deficient in both width and strength. These conditions lend themselves to revisions of both line and grade on practically all the main routes of the system.

Total motor vehicle registration in Turkey in 1947 was 12,913 of which two thirds represented trucks and buses. In 1947 traffic counts showed that vehicles were distributed as follows:

Type	%
Animal drawn.....	70.7
Passenger automobiles.....	10.9
Trucks.....	18.4
Total.....	100.0

The total traffic per day exceeded 1,000 vehicles at only seven stations out of one hundred and ninety, whereas the total motor traffic exceeded 500 vehicles per day at only five stations.

Since 1932, the expenditures made on the national and provincial system averaged about 18,000,000 Turkish liras per year (\$6,500,000 at 2.8 liras per dollar). Experience has shown that this rate of expenditure was not sufficient to maintain the roads already constructed and the new sections completed each year.

The revenues that were used for national highways prior to 1948 consisted largely of appropriations by the General Assembly and 15% of a compulsory road contribution known as a "Poll Tax." The latter was levied on males from eighteen years to sixty years of age, at an annual rate of from 8 liras to 12 liras. These revenues were budgeted and the amount unspent at the end of the year was returned to the general fund for rebudgeting in the following year.

A certain volume of contract construction was completed yearly by Turkish road contractors between specified termini. These improvements were financed by bonds issued in accordance with acts of the General Assembly. Usually these bonds were discounted at the state banks and were matured in succeeding years.

#### CIRCUMSTANCES WHICH LED TO AMERICAN AID

As was apparent to the Turkish people in 1947, progress in highway construction and maintenance was seriously lagging and in the public interest it was imperative from commercial, agricultural, and security viewpoints that steps should be taken to develop an over-all transport policy consistent with national needs. With highway, railroad, reclamation, and port construction under the jurisdiction of the Ministry of Public Works, the time was opportune to initiate and carry forward studies aimed at coordinating the development of transportation facilities.

*Public Law No. 75* (Eightieth United States Congress, First Session, 61 Statute 103), popularly known as the Aid to Greece and Turkey Program, was in keeping with the spirit of the United Nations. Pursuant to this act, an

agreement was signed on July 12, 1947, between the American and Turkish governments on aid to Turkey. Subsequently, it was decided that, of the \$100,000,000 granted to Turkey, \$5,000,000 should be used for highway purposes. It was further decided in October, 1947, by an understanding with the Turkish government and a Memorandum Agreement between the State Department and the Public Roads Administration (PRA) that the PRA would arrange promptly to send a group of experienced highway engineers to Turkey.

#### EARLY ACTIVITIES OF THE PUBLIC ROADS GROUP

The PRA Group arrived in Ankara, Turkey, on December 1, 1947. Prior to its arrival, a receiving center for equipment had been established by a detail of civilian employees of the United States Army at Iskenderun and the training of equipment operators had begun. This activity was transferred to the PRA Group prior to its arrival.

The cooperative activity of the PRA Group, in the words of the agreement between the American Mission for Aid to Turkey and the Ministry of Public Works of Turkey, was—

“The [PRA Group] \* \* \* will assist the Ministry of Public Works of Turkey in establishing a long-range highway improvement program and in establishing a pattern for highway administration on a national scale based upon:

- “A. Inspection and studies of the topography, present condition of the roads and other physical aspects, such as soil types and available local materials;
- “B. Economic studies of present and potential kinds and uses of improved highways, particularly with reference to the national security and the national economy;
- “C. Preparation of estimates of costs of proposed improvements;
- “D. Methods and types of construction and maintenance and their application to the actual operations;
- “E. A study of equipment and equipment-maintenance shop requirements to carry out the proposed program;
- “F. A study and establishment of required highway laboratory facilities;
- “G. Training of Turkish personnel in highway construction, maintenance and administration.”

The American aid funds were used for the purchase of: (1) Highway engineering and construction equipment in the United States and its transportation cost to Turkey; and (2) payment of salaries, office supplies, and other expenses of the chief of the PRA Group and his staff. The budget of the Ministry of Public Works provided for financing the road programs and included such items as purchase of materials, supplies, and rights of way, as well as all salaries, wages, and expenses of Turkish personnel engaged on the program.

No time was lost in establishing direct office contacts between the individual members of the PRA Group and their counterparts in the Department of Roads and Bridges of the Ministry. Fortunately, the department was able to detail English-speaking Turkish engineers as liaison men to reduce the language barrier.

The members of the PRA Group were selected from the experienced personnel of the Public Roads Administration and state highway departments in

the United States. The initial staff sectional assignments, on arrival in Ankara, were: (1) Administration; (2) personnel, finance, and accounting; (3) planning and programming; (4) surveys and plans; (5) bridges; (6) materials; (7) construction; (8) equipment; and (9) maintenance. The characteristic cordiality of the Turkish technicians eased a difficult first-stage development of mutual understanding by frequent conferences; and, at the end of the first two weeks, a well-defined outline had been prepared looking forward to the opening, in April, of the 1948 maintenance, betterment, and construction season.

#### THE PUBLIC ROADS ANALYSIS OF THE HIGHWAY SITUATION

The major objective in administration was to prepare a well-rounded report on the Turkish highway situation. As a result of inspection trips in the field covering some 2,000 km of the primary highways and through conferences with other ministries and with the Public Works Committee of the Chamber of Deputies, facts were arranged so that by late February, 1948, a report on the highway situation was completed by the PRA Group and transmitted to Turkish officials. The facts developed by the cooperative study were sufficiently explicit to permit the suggestion of an action program which would gradually lead to an accelerated schedule.

The report recommended the creation of an autonomous Department of Highways within the Ministry of Public Works to be directed by a commissioner reporting directly to the Minister of Public Works. It called for three staff divisions at headquarters—(1) design and research, (2) finance and control, and (3) maintenance and construction—and recommended the establishment of ten division field offices.

In addition, the report recommended the creation of a highway fund in the Ministry of Finance to receive all funds available for the use of the Department of Highways. It analyzed all present and potential sources of revenue, both for a national system and for a provincial system of highways, and suggested policies for the control of the use of funds from such sources. Appropriations by the General Assembly were to be earmarked for routine maintenance of the national system and for its betterment and construction. All customs duties collected on motor vehicles and their accessories, fuels, and lubricants would be allocated to the highway fund as would a corresponding tax imposed on equivalent items produced in Turkey. The establishment of national fees was recommended for the registration and operation of motor vehicles and the creation of a ton-mile tax for commercial haulers registered as such with the Ministry of Finance.

The report showed that, if its recommendations had been in force in 1946, there would have been available more than 55,000,000 Turkish liras for the national highways and 15,500,000 liras for the provincial systems, which could have been invested for the highway transport users to reduce operating costs. It recommended the establishment of a national system of licensing of operators and chauffeurs at reasonable fees, to be collected by the Ministry of Finance for the Ministry of Police and to be used for the development of an adequate patrol for policing traffic on the national system. This fund, if collected in 1946, would have made available 90,000 liras.

Of the 20,366-km network, about 6,395 km were to be considered for immediate improvement by betterment and routine maintenance, largely in accordance with traffic requirements. There were about 800 km of asphalt-surfaced roads in good condition and 7,800 km of passable macadam roads. On much of the passable macadam, a speed of only about 25 km per hr could be maintained. Thus, it could be concluded that the national system should consist ultimately of almost 35,000 km of arterial routes connecting all major centers of population.

Stage construction was recommended to secure, at reasonable cost, the maximum mileage of two-lane, all-weather roads with adequate bridges. Traffic needs indicated that stabilized soil, gravel, or macadam surfaces should be preferred and that more detailed attention should be given to the methods used in all earthwork and grading operations, particularly in consolidating fills and in using stabilized subbases. After consolidation by traffic, and as the need developed, existing surfaces should be given bituminous-surface treatments, to be followed later by plant or road-mixed bituminous surfaces. To lessen right-of-way difficulties in future years, it was recommended that the available controlled width of rights of way on all rural national highways be at least 35 m, that at entrances to municipalities it should be at least 55 m, and that no new buildings should be permitted within those limits.

The activities of the Planning and Programming Section of the Design and Research Division of the Department of Roads and Bridges were initiated at once. The cardinal principle adopted was that all work should be pointed toward an analysis of the economics of the rail, highway, water, and air transportation in Turkey, with the ultimate aim of logically coordinating these four systems from both civil and national security viewpoints. Other studies included:

- (a) A physical field inventory of all national highways and bridges, including all adjacent culture, started and finished in 1948;
- (b) A traffic survey, planned and completed in 1948, to determine volume, classification, weight, physical dimensions, and origin and destination of all vehicles using the national system of highways; and
- (c) Financial studies, amplified to include all sources of highway revenue and the probable impact of these revenues on the entire Turkish economy.

In arranging the programs for 1948 on the national system, the policy determined was that the major part be on a pay-as-you-go basis with emphasis on the extension of routine maintenance and betterments, on the extension of two-lane all-weather roads, and on the construction of essential bridges by the Department of Roads and Bridges. This program was to be expanded as rapidly as finances would permit.

The Department of Roads and Bridges had always contracted for its surveys and plans for roads, although bridge plans were prepared by the staff. It was recommended that department forces should make all surveys and plans and that they should proceed aggressively with the preparation of a shelf of plans for roads and bridges on a priority programming basis, all this field work to be based on the principles of highway transport economics as used in the United States.

In recommendations regarding the new Division of Finance and Control, particular emphasis was given to strengthening personnel policies and to establishing a classified list of positions to be filled by candidates on a career basis, thus preventing the former excessive turnover in employment of technical personnel. It was suggested that a new accounting procedure be adopted, that the national highway system be divided into control sections about 100 km long for accounting and administrative purposes, and that the accounting system be designed to permit the accumulation of cost and road life data for use in future budgeting and programming. The system was to be arranged for easy distribution of expenditures, by control sections and by purpose of expenditure.

From information supplied by the Ministry of Public Works during the exploratory survey it was evident that the engineering personnel had received careful training in Turkish, European, and American universities, but practically nothing was being done, by laboratory and field tests, to study and control the construction materials used. A complete physical and chemical testing laboratory was ordered and immediate steps were taken to establish standards for studying, testing, and coordinating the use of materials.

Recommendations for roadway design were based on the fundamental condition that road standards, vehicle registration, and vehicle taxation must be in fair balance. Taxation should be at reasonable rates because the returns would result in transportation at lower cost and thus would warrant more material expenditures for maintenance, betterments, and new construction as the improved mileage increased.

To meet the national highway system requirements for the foreseeable future, designs for alignment, grade, cross section, and surfacing should be premised on fast-moving motorized traffic. The minimum standards recommended were based on estimated operating speeds for flat, rolling, and mountainous topography. Design speeds were 75 km per hr, 60 km per hr, and 45 km per hr. The sharpest curvatures were to be 6°, 10°, and 20° and the maximum grades were to be 4%, 8%, and 10% (for a maximum distance of 300 m in one continuous section). Minimum sight distances were to be 125 m, 100 m, and 70 m for both vertical and horizontal curves. The minimum width of all-weather surfacing was to be 6 m, with suitable increases at curves and on the more heavily traveled routes, and the minimum width of roadbed was to be 9 m.

Bridges were to have a clear width of roadway of at least 7 m and a minimum vertical clearance of 4.25 m. The standard loading was to be 13.6-metric-ton trucks suitably spaced. For design purposes, 4,100-kg pneumatic-tired wheel loads were to be used. The wheel load was to be considered as half the axle load.

It was recommended that continuing studies be made of all engineering standards that apply to various phases of highway design, maintenance, and construction and that coordination be established in all operating divisions by the continued issuance of memoranda covering engineering standards.

In developing standards for contract work, definite recommendations were made, largely in consonance with American highway practice: For control by the engineering section, for prequalification of contractors, for filing of job plans by contractors indicating staff and equipment, and for verification of financial responsibility.

In the interest of highway safety, it was recommended that a Committee on Safety be formed with the Commissioner of Highways as chairman and including as members representatives of the Ministry of Finance, Ministry of Education, and Ministry of Police. This committee should establish a traffic bureau to be operated by the Ministry of Police and staffed by specially trained personnel, and should immediately sponsor the preparation of a manual on uniform traffic control devices.

#### MATERIAL ACCOMPLISHMENTS FOLLOW

This general preview of the cooperative activities prompts the query as to what was accomplished by the sixteen men engaged in administrative and engineering duties and by the eleven equipment instructors and operators during 1948.

Administratively, the chief of the Department of Roads and Bridges and three deputies organized the department along the lines suggested in the report. A basic highway law was prepared and approved by the Council of Ministers of the Turkish government, for submission to the General Assembly in November, 1949. This law creates an autonomous department with continuity of financing as suggested in the report.

A further detailed and enlarged economic report was prepared, the agenda being kept up to date by the Planning Division. This report was helpful in giving the detailed information needed by the Turkish government when it applied to the Economic Cooperation Administration of the United States for a loan of \$5,000,000 which would make possible the purchase of additional American equipment and pay administrative expenses. This loan was approved.

The highway budget for 1948 was 38,000,000 liras. The budget approved for 1949 was for 50,000,000 liras.

Study of the personnel, financial, and accounting procedures of the Department of Highways has been continued. Changes were made gradually but the complete readjustments could not be put into effect until after the approval of the basic highway law.

Late in 1949 the Planning and Programming Division consisted of about twenty engineers and analysts. A study was completed and approved covering a national highway system of more than 20,000 km. Maps were made for a suggested integrated system of provincial roads of about 21,800 km, to be submitted to the provincial governments for their consideration. It is estimated that the national system ultimately will be about 35,000 km long.

A physical inventory of the national system was completed and a preliminary traffic survey was made in 1948 to determine volume, classification, weight, origin and destination, and commodities carried. The commodity classification used was that of the Turkish Railway Administration. During the fall of 1949, three inventory parties and four traffic survey parties were in the field working on predetermined schedules.

These diverse field and office studies should be helpful in solving the economics of highway location and relocation which are many and varied in a country of such rough topography with such diverse living standards and pursuits.

The PRA Group received prompt and cordial cooperation from all departments of the ministries of Public Works, Agriculture, Finance, Economics, and Transportation. Many technical studies were available in the universities and in the technical schools of Ankara and Istanbul. Such fundamental and reliable facts as population trends, rainfall distribution, production and consumption of commodities, and classes and types of agriculture were quickly available. Many complete studies were furnished on present and potential mining developments, prospective irrigation and flood control projects, port development, and power development resources.

The work of the Division of Surveys and Plans was organized in accordance with the general practice of the Bureau of Public Roads and of state highway departments in the United States. Both field and office procedures were new to the Turks and courses of instruction were necessary. Late in 1949, the Department of Roads and Bridges had twenty-one survey parties in the field and twenty engineers in the central office section of the Division of Surveys and Plans. Modern American equipment is used. During 1948, complete field surveys were made on 450 km, center lines were established on 694 km scheduled for betterment work, and contract drawings were made or checked on 228 km for immediate construction by Turkish contractors.

The Bridge Division largely concerned itself with designs for the most important structures. It was reorganized to deal with all types with emphasis on relatively simple bridges such as steel pile bents, with creosoted timber decks, and on designs for masonry and concrete culverts. The preliminary estimates from the road inventory indicated that more than 80 km of bridges should be built within a decade.

During 1948, designs were made for steel pile bent structures, and local materials assembled for the first 35-m bridge. The steel came from the Turkish Karabuk Steel Mills, the timber from the Turkish Forest Service, and the creosote from the steel mills.

A crawler-type crane was equipped as a pile driver, the leads, hammers, and jigs being designed and assembled locally by the Turks under the advice of the bridge engineer of the PRA Group. The first bridge was completed in seven weeks by a trained Turkish bridge gang. Other bridge gangs then were organized. All cranes, compressors, welders, and miscellaneous items were of American manufacture but the pile leads, hammers, boom extensions, jigs, and tools were fashioned in Turkey.

The first reinforced-concrete culverts, new to Turkey, presented a problem. All manufactured materials for construction are in limited supply. Portland cement, for instance, is rationed on a priority basis and crushed stone is difficult to obtain.

The physical testing laboratory furnished under the program was installed in the Ministry Building at Ankara. A training program in laboratory and field procedures was inaugurated in December, 1947. The soils and bituminous and concrete sections, using Turkish personnel entirely, perform all necessary routine functions and tests. Local gravel and quarry sites are investigated, the bituminous materials of Eastern Turkey are tested, soils are studied, and standard tests are initiated on other materials of construction.

The Construction Division, as reorganized, directed the construction of three central machine shops during 1948 and had the added responsibility of revamping specifications and contract forms and methods, with particular emphasis on cost records. The division, for the first time, handled field engineering and inspection on contract work.

During 1949, the construction of nineteen additional division and district shops and of three division office buildings was completed in time to receive and install new equipment purchased under Economic Cooperation Administration financing. For the first time, winter overhaul of all construction and maintenance equipment is possible. Many capable Turkish contractors, experienced in railroad construction, have become interested in the highway field. Because of world conditions, they have been forced to use hand methods. Now construction equipment can be imported to expedite and thus make possible more work—at lower prices. There has been excellent cooperation with Turkish contractors on the work already undertaken. One Turkish engineer reported that the cost of projects built with American equipment was from 40% to 55% lower than the cost of similar projects built by the old hand-labor and team methods.

In the Maintenance Division (office and field) the addition of mechanical equipment has forced a complete reorientation of procedures. Any change, however, must be effected gradually because in a primitive country training of engineers and operators is essential prior to the arrival and the allocation of equipment. It has been found that the rate of absorption of equipment has to be given careful consideration so that it can be assigned for work immediately on arrival. For instance, it was necessary to train twelve complete units of men for the operation and maintenance of rock crushers and quarry layouts to make prompt use of those units on arrival. The same detailed training has been necessary for other equipment, such as compressors, drills, jackhammers, concrete mixers, bituminous distributors, road graders, steam shovels, cranes, bulldozers, and carryalls, not to mention automobiles and trucks of various kinds.

The adaptability of the Turkish worker and mechanic has been an essential aid in the development of the program. Road drags and jigs of various kinds have been built in quantity from designs made on the ground by the PRA Group; and foremen and mechanics have been trained and have accepted their new responsibilities.

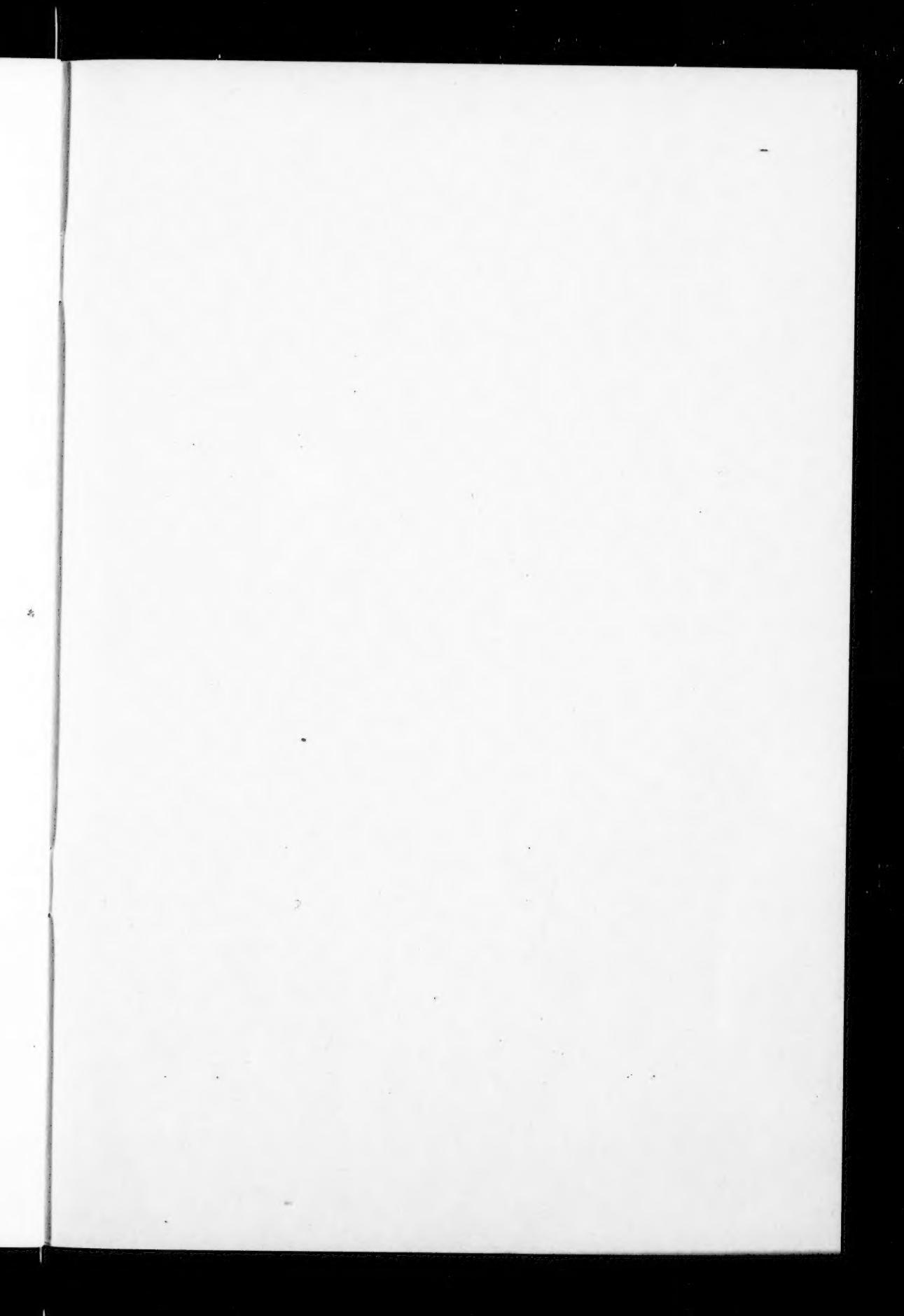
During the first year, much of the operator training was done at the receiving center at Iskenderun on the Mediterranean. More than six hundred and fifty operators completed the training course of about six weeks. During the first year, the trainees built a 6-km distribution route around the City of Iskenderun.

The receiving center includes shops, warehouses, servicing stalls, storage facilities, and a spare-parts warehouse. The layout is well arranged for prompt assembly and dispatch of equipment—for instance, six trucks can be serviced, oiled, and greased at once. The receipt, storage in bins, and forwarding of spare parts is no easy task. It is necessary to translate the names of all items into an old or a new Turkish word that will become standard nomenclature and that will be readily understood both by the sender and by the receiver. The best American practices were taught and used.

## SUMMARY

In this short paper, an attempt has been made to describe the progress made on a "Point Four" project initiated in late 1947. The Turks are a home-loving and a country-loving people. Their reactions on an active program for highways has been surprisingly like that of the average American and they are somewhat astounded by the rapidity with which their own engineers and workmen have been able to translate words into action. This assignment has proved that, through close cooperation, the PRA Group and its Turkish associates in the Ministry of Public Works have proceeded to plan and carry out in the field a highway program fitted to the Turkish economy, which in the short time of nine years should open up a complementary form of motor transport that will benefit the economy of all parts of the Turkish Republic.





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